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PRIMITIVE CARRIERS IN LAND TRANSPORTATION[1]

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The Egyptian obelisk which adorns Central Park, New York, is one of the few objects that represent in their history phases of both ancient and modern methods of transportation. Hewn from the syenite of Assuan, it was transported over 600 miles to the present Alexandria, where it stood for many centuries. No one knows how many years, how many thousands of men were spent in the slow, tremendous labor of dragging the huge monolith from Upper Egypt to the edge of the Mediterranean.

Then came a time when it was loaded in the hold of a steamship and in a brief period was transferred by water and up through Manhattan Island to its present place. Mechanical science made this final journey, fraught with some difficulty, to be sure, a mere bagatelle as compared with its first removal many ages ago.

The old and the new still jostle one another in our land. The "prairie schooner" has not quite passed into history. It has often been seen this year entering our western mountains, carrying the family gods to better lands, perhaps to some fertile valley in Montana where the cattle, trailing behind it, may find richer grazing. Meanwhile a man, traveling on the second fastest train between

[1] The author wishes to acknowledge his indebtedness to the United States National Museum, the Smithsonian Institution, the Bureau of Good Roads and the Congressional Library of Washington, D. C.; and especially to thank Mr. W. C. Wheeler of the U. S. Geological Survey for his kind assistance.

The illustrations of this paper are from photographs of models exhibited in the National Museum at Washington except Fig. 2, which we owe to the courtesy of Professor Hiram Bingham of Yale University.

Chicago and New York, writes that he sat down to breakfast with the Catskills still in view and when he adjourned to the smoking car he was abreast of Newburg.

The writer will endeavor to show in this paper the steps by which land transportation, propelled only by the muscular strength of men and animals, has advanced to its present position.

In the lowest stages of human culture the method of transportation is correspondingly primitive. Man, himself, is the means of traffic and transportation. A higher stage in the development of culture comes in with the breeding of animals. Social life is then more complex. The family is no longer the only unit. Then is developed the idea of the tribe, which among many hunting and fishing people had such an indefinite meaning that we cannot ascribe any importance to it. The tribe was the result of the union of several families brought together by the need of strength and power. Tribal peoples respected the right of private ownership. The men grouped themselves for the purpose of protection. Animals represented their most valuable property and the increase of herds created the nomadic life. Having exhausted one pasturage, they were forced to look for another, and so families with all their property were transferred to other scenes. Transportation became more advanced among these people and they learned to use animals as beasts of burden because they had heavier loads to transport than before. Later they used vehicles, and other means of easy transportation.

The next important step in human culture was the development of agriculture, which was accompanied by the fixed settlement of peoples on lands adapted for their need. By cultivating their arable land, they were able to supply themselves and their herds with food and thus surmounted the need of wandering. This is the period in the history of mankind, when the supply of produce exceeded the family demand and man began to turn the surplus to account by exchanging crops and cattle for other commodities. Thus among some peoples the germ of commerce was in agriculture.

Primitive industry was especially to be noted among fishing and hunting peoples; but the highest degree of human culture brings with it the development of advanced industry. Commerce is one of the results of this later age, but the fruits and products of the human mind, the inventions and the sciences, are the most precious possessions. Transportation, as the facts here given show, is an important consideration in discussing the growth of culture, because it im-

proves with human development. It is a dial by which we may measure the advance of civilization.

Transportation as Influenced by Environment. Land transportation is different from water, and this again from aerial transportation. Environment is in every case the determining factor. Aerial transportation is the most difficult, as well as the hardest to perfect. The problem in the solution of this question is to overcome gravity. The most recent triumph of modern technic has solved this question by producing bodies of large surface and light weight (aeroplane and airship). Transportation on rivers and lakes and along the seashore was practiced in the very early ages of mankind. Ocean crossing claims more advanced methods and a more advanced stage of human civilization. In this paper, water transport will not be treated in detail, as land transportation is especially in view.

Morphology and Land Transportation. In the discussion of land transportation, some reference will be made to the morphological character of regions. The method of transportation and the morphological character of a region are so closely related that we are able often to name the morphology of a region even from a simple reference to its method of transportation; and *vice versa* the morphology of a region suggests its methods of transportation. When a desert is mentioned we know at once that animal power is the method of transportation, and we also know that it is represented by the camel or its equivalent; and if we mention the camel, a desert is the morphological region at once brought to mind.

In our further discussion, there will be some occasion to speak of the different morphological regions. The following classification will be used:

1. Sandy and gravelly shores (sea- and lake-shores); 2. Plains (lowlands and plateaus); 3. Hilly lands (sand dune regions included); 4. Mountains of moderate height; 5. High mountains; 6. Deserts; 7. Virgin forests.

The last two terms in this classification may seem questionable, since there are lowlands, plateaus and hilly lands, which may also be deserts or virgin forests; but because the notion of desert is connected with a particularly dry, and that of the virgin forest with an extremely wet climate, we may distinguish these two morphological regions from those above mentioned, in order to secure for them an independent position in our system. In nature the distinction is not so sharp between these morphological regions as it appears to be in our classification. Even the transitions in morphological regions are so gradual that the strict classification of a cer-

tain country is often difficult. This appears in the case of the broad beach of a sandy shore, which extends out into the zones of the front dunes (fore dunes) and still farther inland into the dune ranges of a different kind, all of which run nearly parallel to the shore line. We encounter the same uncertainty in the transition of hilly lands into regions of high mountains.

In discussing the different methods of land transportation, I wish to call attention to the classifications of Prof. Charles H. Cooley[2] and that of Prof. Hermann Wagner.[3] Cooley distinguishes four kinds of transportation methods:

1. Human burden-bearer; 2. Animal burden-carrier; 3. Vehicle (man and animal in traction); 4. Modern machines.

The classification of Professor Wagner differs from that of Cooley in the first, second and last headings only in the terms used. The third heading is divided into two parts, the sled and the wheel vehicle. We shall neither follow the classification of Cooley nor that of Wagner, but shall use one which is a combination of the two, but much simplified.

Land Transportation Carriers. To carry on transportation, it became necessary to construct vehicles and to vary them according to the obstacles met. Primitive means of transportation overcame only a few obstacles. Only at a later stage did the obstacles disappear one by one and increased rapidity of motion became noticeable. As ideas grew and methods of construction improved, less time was consumed in making the same distance; and now we have the contrast between the sled and the automobile. In every case the development of the carriers reflects the degree of culture of the people and of the age; hence the description of each type of carrier reflects the cultural history of its time.

The most primitive carriers are those which are based purely upon muscular power. Man and animal are the carriers. At first the human being bore the burden (Fig. 1), especially the women, whose subordinate position explains the fact. Later on we find the men among the burden bearers. Some carried loads upon their heads, others upon their shoulders, still others upon their backs. According to Herodotus the women of Egypt carried loads upon their shoulders and men carried loads upon their heads. The Indians used a burden strap, which "was commonly worn around the forehead and lashed

[2] C. H. Cooley, The Theory of Transportation, *Publications of the American Economic Association*, Vol. 9, 1894, pp. 20–30, Baltimore.

[3] Hermann Wagner, Lehrbuch der Geographie. 9. Aufl., Hannover und Leipzig, 1912, pp. 909–913.

FIG. 1—Human burden-bearer (Korean).

to a litter borne on the back."[4] This manner of burden-bearing dates back to prehistoric times, but it survives even to-day. Among many of the inhabitants of Africa, Polynesia, Madagascar, Borneo, Celebes and some other regions this is still the only means of land transportation. It has survived even in modern countries, especially in mountainous districts, and among such wandering folk as the Slovaks of North Hungary, who make a livelihood by repairing windows and kitchen furniture; also among wandering Bosnians and Herzegovinians, who traffic in different wares and carry their "shop," which is a basket, upon their shoulders or heads. In rare instances we find this most primitive method of transportation even in civilized centers, where it is used for carrying burdens short distances, especially in the transportation of passengers in chairs, in Japan and China.

Animals take the place of man for carrying heavier burdens. Various animals have been used for this purpose in different ages and regions. The ass,[5] horse, mule, ox, yak, water buffalo (the so-called Indian buffalo and the Cape buffalo), zebu, llama, camel, elephant and ostrich are the most common. Single animals carry loads upon their backs (in basket, box, sack, etc.). Laden horses, camels, and other animals were driven in tandem in the fourteenth century, in Algeria, Persia, Morocco, China and France. Figs. 2, 3 and 4 illustrate some of these burden-bearing animals. Their use goes back to the oldest historical times and in regions without distinct roads, as among high mountains, deserts and virgin forests, where they are still the only means of transport. The horse and ox are cosmopolites, but the ass and mule are chiefly found in southern regions. The yak is a burden bearer in Tibet, the water buffalo in southeast Asia, and the zebu in India. The camel is used mostly in the deserts of Asia and Africa, the elephant in the forest regions of India and Africa, and the llama in western South America.

Vehicle Carriers. Man thought of constructing vehicles only when he wished to transport loads too heavy to be carried upon the backs of man or animal. He found the employment of vehicles both expedient and economical. One man or animal could thus transport a much heavier load. With these carriers came, in time, the necessity of making artificial roads, especially in rough country; but

[4] J. L. Ringwalt, Development of Transportation Systems in the United States. *Railway World*, Philadelphia, 1888.

[5] The ass was domesticated probably before the horse. Marshall M. Kirkman, Classical Portfolio of Primitive Carriers, The World Railway Publishing Co., Chicago, 1895.

FIG. 2.

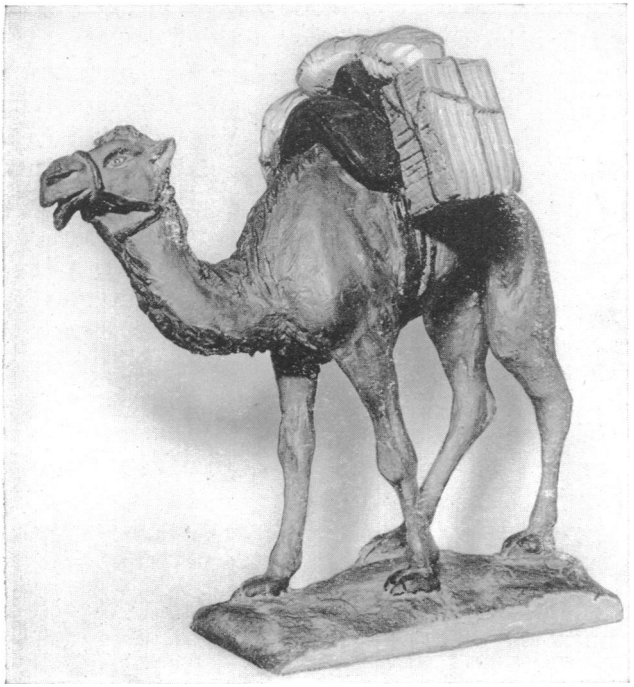


FIG. 3.

FIG. 2—Group of llamas in Peru.
FIG. 3—Arabian camel.

roads came later and with the improvement of vehicles. At first the roads were merely the paths or trails of man or animals.

Vehicle carriers are driven either by muscular power or machinery. The muscular power is supplied by man and animals. Besides the animals mentioned above, there are also used for traction, reindeer (in the extreme northern regions), dogs (in Germany, Belgium, Austria, Holland), pigs (in Austria-Hungary), and goats (in Austria, Germany, Switzerland, and other countries), for drawing children's wagons. The germ of muscular power carriers is to be seen in the *travois* of the Indians. They fastened one end of the poles of their tent to the sides of their horse, and let the other ends free to drag. Upon these were placed the tent, skins, other baggage, and even the children and women. They transported their food and hunting spoils in a similar way. This contrivance was simple, yet it had great importance in the history of civilization.

The next step came in the use of rollers (Fig. 5) for transporting heavy building stones. This carrier had not yet a definite form. Two or three rollers were placed crosswise upon narrow planks, and upon these the stone. This device is still used. It is not economical in point of time, since it can be drawn only about the length of the stone[6] before readjusting the rollers.

Carriers with definite forms were a great improvement. To these belong the sliding and wheeled carriers of muscular-power vehicles and machine vehicles. The first vehicle with definite form showed only slight evidence of man's handiwork. The Indians of North America took a forked limb of a tree, placed three smaller pieces of a limb across it, and in this way the first type of the sledge was made. After a time, when they had to carry heavy loads, they were not satisfied with this simple carrier, by which the load was raised only a little above the surface of the ground. They invented the built-up sled which decreased the friction and increased the speed. This was in many countries the first carrier in which the whole vehicle was high and the load did not come in contact with the ground. The sled is not necessarily the product of snowy mountain regions, because it is in use elsewhere. The Egyptians used it to transfer building-stones,[7] and it is in use even at the present time in Madeira and on the Canary Islands, where snow never falls. In Asheville, North Carolina, and in many other places in the United States, we find this contrivance, its use being re-

[6] This form is extensively used in moving many large objects, as houses.

[7] O. T. Mason, Primitive Travel and Transportation. *Ann. Report of the U. S. National Museum for 1893-94*, pp. 239-593; reference on p. 545. Washington, 1896.

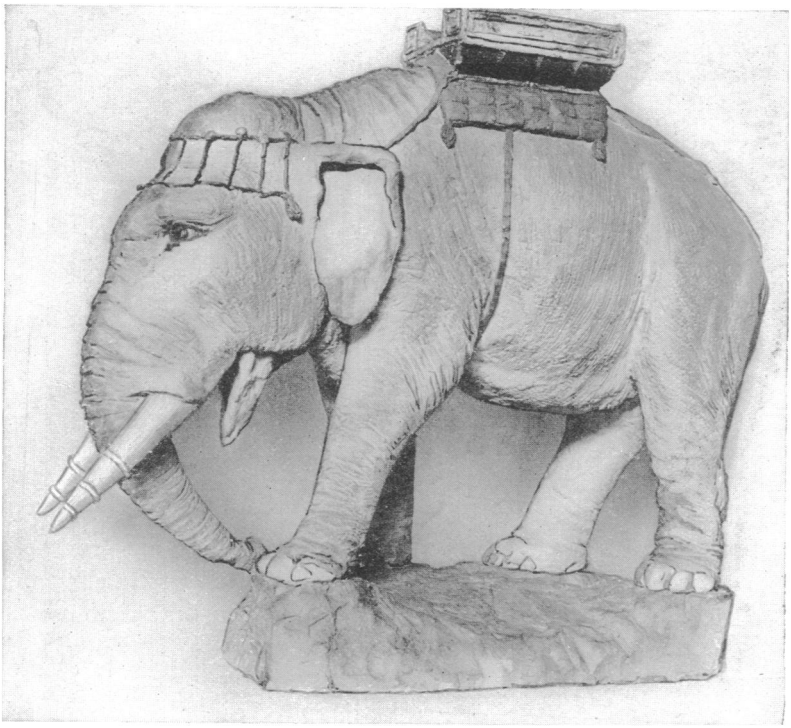


FIG. 4.

FIG. 5.

FIG. 4—Indian elephant.

FIG. 5—Use of rollers for transporting heavy building stones.

stricted to even or not very rough land surfaces, such as a meadow, or a very steep hillside. Modern sledges were developed from the built-up sled type, and differ from it mostly in the additional upper part, which may be a basket or body.

The use of springs soon followed, the great importance of which will be noted later. The canoe-shaped carrier drawn by two oxen and used in Syria is also to be mentioned. The boat-sled often used by Arctic explorers, is both a sled and a boat. It is a boat placed upon a sled. Another combination is made by attaching wheels to the boat-sled, as in the burial carriage used by the Egyptians. To this group also belong the snow shoes used by North American Indians, the ski of Scandinavia and the skate of to-day.

The friction was too great among the sliding vehicles. It was desirable to decrease it. This question of decreasing the friction was solved by the transitional type of muscular-power vehicles, as the Egyptian rolling sled (Fig. 6), which was carried on rollers placed below the sled runners. These rollers not only decreased the friction, but also added to the speed of the vehicle. The transportation of marble columns in Greece was facilitated by encasing the column in a wooden frame (Fig. 7), to reduce the friction and increase the speed. Its special disadvantage was the danger of damage to the enclosed marble. Of the same type are the barrel-vehicles, the tobacco-rolling hogshead and the rolling tar barrel (Fig. 8) used in Virginia and in North Carolina until the middle of the last century. More advanced is the cylindrical framework of the Greeks, to transport marble prisms (Fig. 9). Its purpose was the protection of the object in transportation and the increase of speed. The most improved type of the transitional muscular-power carriers is the Nantucket fish cart represented in Fig. 10. The barrel in front of the box serves for a wheel, and is not a direct carrier itself. Its use is restricted to the sandy seashore. Narrow wheeled vehicles run with much difficulty in sandy soil, and this fact explains the use of this primitive vehicle in our time.

We cannot fix the date of the first appearance of wheeled vehicles. We know, however, that some 5,700 years ago Sharrukin, King of Agada, Mesopotamia, made his invasion to the Mediterranean in chariots. The Chaldeans, Assyrians, Phœnicians, Persians, Greeks, Romans, and other peoples of ancient and mediæval time used wheeled vehicles. There were many styles of these carriers. They seem first to have been used for carrying heavy articles, and so the wheels were made solid and massive. Natives of Central America

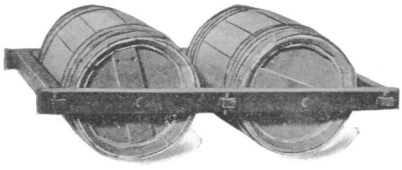


FIG. 8.

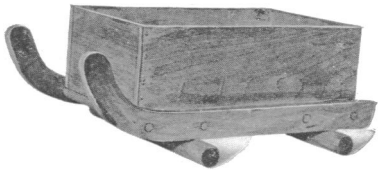


FIG. 6.

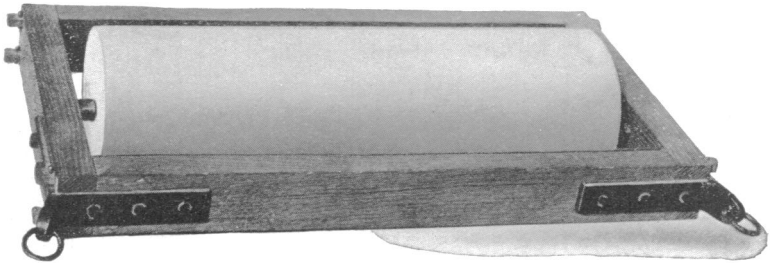
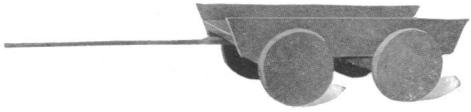


FIG. 7.



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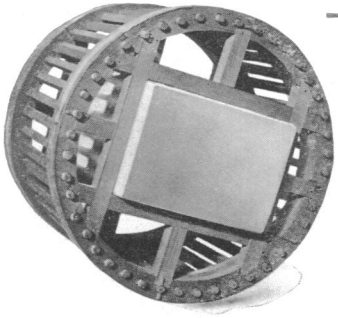

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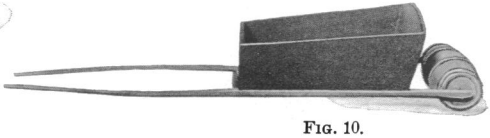


FIG. 10.

FIG. 6—Egyptian rolling sled.

FIG. 7—Wooden frame used by the Greeks to transport marble columns.

FIG. 8—Types of barrel-vehicles (tobacco-rolling hogshead and rolling tar barrel) used in Virginia and North Carolina up to 1850.

FIG. 9—Cylindrical framework used by the Greeks to transport marble prisms.

FIG. 10—Nantucket fish cart.

FIG. 11—Greek *scytala*.

fastened two solid wheels under a plank with a donkey as motive power. The solid wheels were entirely of wood, cut from a tree trunk. That vehicles with four wheels were of later date is an historical and a logical fact. Two-wheeled vehicles were easier to construct, more capable of withstanding hard usage on an uneven, rugged surface. The next step from the Central American cart leads us to Aristotle's *scytala* (Fig. 11). Its four wheels marked a more advanced stage in wagon making and the running gear was somewhat improved. The axle and wheels were of one piece, and the axle was attached to the bottom of the body by leather straps.

More advanced still is the Russian Bashkir child's coach (Fig. 12). The solid wheels revolve here upon the axle and the body of the vehicle is attached to the running gear by straps. Next came the Roman oil and wine cart and the Roman farm *plaustrum* (wagon) (Fig. 13). From one to four strips of wood are nailed across the solid wheel, apparently to strengthen it. The construction of the running gear is not very complete and may perhaps place it among the two preceding types. The body is a basket, set upon the running gear. The historical and geographical distribution of these vehicles is extensive. We meet them not only among the ancient nations, but also to-day in Siam and Burma, the British Isles, Ceylon, India, Japan, California, Mexico, Chile, Siberia, Russia, Servia, Bulgaria, Turkey, and elsewhere.

At a later period solid wheels were no longer constructed, as it was found that strength was not entirely dependent upon solidity. The wheels of the Spanish *carreta,* used to-day in New Mexico and Arizona, and that of the Burmese car of state (Fig. 14), are not wholly solid. The wheel is built up of three parts, with a little space between each part. We meet this type in Mexico, Portugal, Chile, Brazil, and other countries, each showing its own modifications of the original model.

As time advanced, the wheel was composed of more and more parts. The parts of the wheel of the Burmese car of state were chiefly of the same piece of material, but the type used in India (Fig. 15), produced by more skilful wheelwrights, were made of different materials. With the appearance of the spokes, we distinguish at once the felly, spokes and hub. We find from four to twenty-one spokes. They are for the most part arranged in one plane, and their purpose is to connect the opposite sides of the felly. A Turkish wheel type, however, has the hub outside of the felly plane, and in such a way that the hub is nearer to the body of the

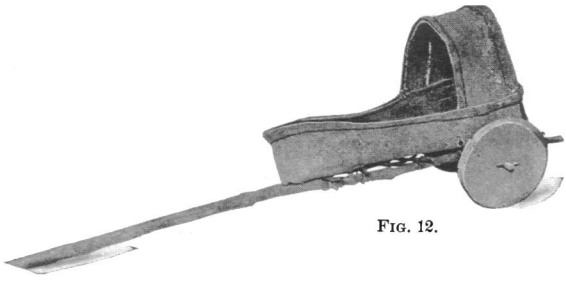
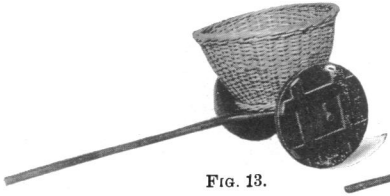


FIG. 12.



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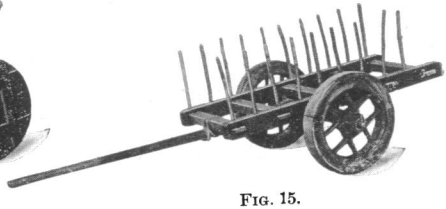

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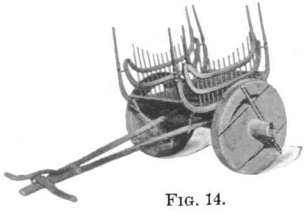

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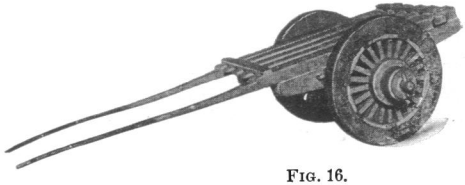

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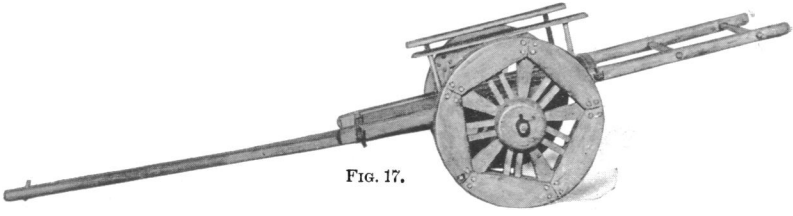

FIG. 17.

FIG. 12—Russian Bashkir child's coach.

FIG. 13—Roman farm wagon (*plaustrum*).

FIG. 14—Burmese car of state.

FIG. 15—Indian cart.

FIG. 16—Japanese cart.

FIG. 17—Persian farm cart.

vehicle than the felly. An analogy to this is found in the bicycle of to-day, with the difference that the spokes of the wheel run to the two ends of the hubs. The wheels of the Indian type contained eight, or more precisely four, double spokes and four felly parts, the Japanese type (Fig. 16) shows twenty-one spokes and seven felly parts. The hub is of two parts, and very strong, as is the felly also, their purpose being to carry very heavy loads.

In the Persian farm cart (Fig. 17) is a striking variation in the form of the spokes. The five longer and thicker single spokes connect the joints of the five felly parts with the hub; the five double shorter and thinner spokes connect the middle of each felly part with the hub. The polygonal shape of the inner wheel-surface is peculiar. It is a type which we find in Germany (sixteenth century) as well as in Servia to-day, and elsewhere, with the small difference, that the one in Germany has ten spokes and ten felly parts, the one in Servia seven spokes and five felly parts. The shape and location of the spokes is very different in the triumphal cars and war and race chariots of Germany, France and other countries, in different ages.

All these wheeled vehicles, except chariots, were used mostly for heavy loads on rough roads and for that reason were clumsier and stronger. Later, when they were introduced for purposes of war, and for passenger transportation, they had a lighter and more elastic form, as we see in the chariots of the ancient nations.

The Greek and Roman *biga,* the Greek *scytala* and *diphron* are all two-wheeled vehicles for the purpose of war and for racing. The warrior and racer stood up in the chariot. The seats of the vehicles came at a later date. The two following photographs represent Egyptian chariots. That from the Ptolemaic era (Fig. 18) is very primitive. It was built of wood and the parts were held together by rawhide straps.

In the Egyptian chariot of the third century, B. C. (Fig. 19), constructed of metal, a decided advance is seen over the earlier vehicles which were entirely of wood. The introduction of metal signifies a turning-point in the history of vehicles. The wheels were covered with metal tires, or were roughly shod, like those of the Assyrians and Persians; the axle is of metal and the hubs are lined with metal to prevent friction and the wearing away of axle and hub. The Scythians and Gauls before the Christian era, and the Britons of the first century, A. D., used also scythes on the hubs of their wheels, as well as on the sides of the body of their

FIG. 20.

FIG. 19.

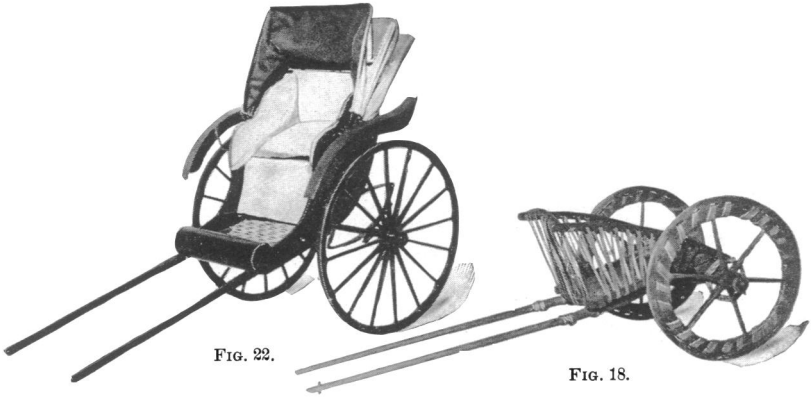

FIG. 22.

FIG. 18.

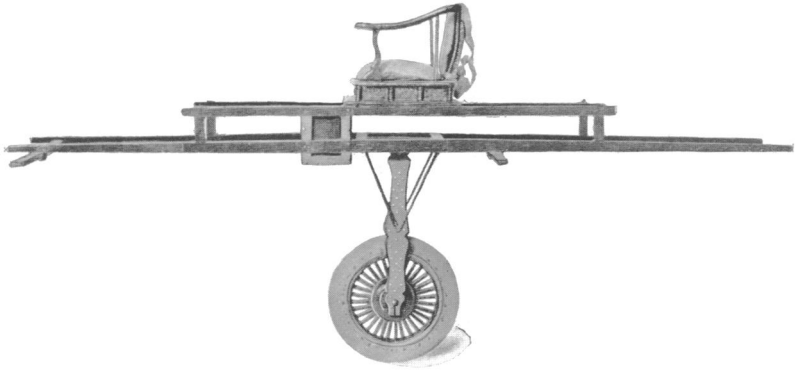

FIG. 21.

FIG. 18—Egyptian chariot of the Ptolemaic era.

FIG. 19—Egyptian chariot of the third century B. C.

FIG. 20—One-wheeled Chinese vehicle.

FIG. 21—Korean royal vehicle (one-wheeled).

FIG. 22—Japanese jinrikisha.

wagons for offensive purposes. In some vehicles even the spokes of the wheels are of metal, or the whole vehicle is of metal, as in the Egyptian chariot (Fig. 19).

The one-wheeled vehicle of the Chinese (Fig. 20), used for passengers and all kinds of freightage, belongs to the group of vehicles with metallic parts. The loads are placed on both sides of the wheel, or behind it. To this group belongs the Korean royal vehicle (Fig. 21), in which the tire of the wheel is of metal plates riveted together over a wooden foundation. The lightness of the wheel gives elasticity to the vehicle and increases its speed.

The improvement in vehicles reached its highest degree in the introduction of springs and india-rubber. Springs were used for the first time in the second half of the eighteenth century and elliptical springs in the first years of the nineteenth century. At first they were used only for passenger vehicles, taking the place of the leather supports that held the body of the vehicle. In the nineteenth century, before the invention of railroads, the bodies of the stage coaches generally in use were hung on these strong leather straps. The purpose of the springs as well as of the leather supports is the same. They not only save wear on the coach, but also contribute to the comfort of the passengers.

Without referring generally to passenger vehicles supplied with springs, attention may be called to the Japanese jinrikisha (Fig. 22), and to British and American two-wheelers in the passenger service as special forms. The American type differs from the Japanese in that the load is carried on the back part of the coach, and the propelling is represented in America by the horse and in Japan by man. The literal translation of jinrikisha is "man-power car."

Wagons with springs for transporting heavy loads were products of the last eighty years of the nineteenth century. The application of springs is not universal partly on account of their cost. India-rubber is an aid to the springs, its purpose being to diminish the percussion and to increase comfort. This is also an invention of the last years of the nineteenth century. The roller-skate has either two or four wheels, and with or without india-rubber.

In summarizing these remarks on the development of muscular-power vehicles, it may be said that they were at first made entirely of wood, then partly or entirely of metal, and later were improved by the introduction of springs and india-rubber. The development of the wheel has been traced from the solid wheel to those that were partly solid and then finally provided with spokes. Many small

differences and improvements have not been mentioned because they add nothing of importance to the history of the development of vehicles. The chariots were for other purposes than either the American two-wheeled gigs or the Japanese jinrikisha.

We have discussed the development of the primitive transportation carriers, without treating vehicles propelled by machinery, the second part of the group of vehicle carriers. By understanding the development of human culture, we are enabled to understand the development of vehicles. The high degree of culture among the ancient peoples brought with it so complete an adaptation of vehicles to human needs, that the mediæval nations contributed almost nothing to their improvement. Only the nineteenth century brought great change, and especially in the last eighty years has the progress completely overshadowed the efforts of the previous five centuries.

THE ISLES OF CALIFORNIA

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The first thirty years of exploration in and about the great South Sea, after its discovery by Balboa, cleared up many of its major problems for both navigators and geographers. Magellan's voyage had given a true conception of its size; Juan Fernandez had solved the difficulty of the navigation of the southern part, and the new ocean had in fact already been crossed at least twice from the western coast of New Spain: first by Juan de Saavedra in about 1527, and again by Ruy Lopez de Villalobos in 1542.

These trans-oceanic voyages had, however, so far all been made in the one direction, from east to west, since no navigator had as yet solved the problem of battling with the trade winds. In the meanwhile coastwise exploration had been carried on both north and south from Darien, and some little knowledge gained of the adjacent lands.

Among other points which would seem to have been adequately settled by this time was that as to the true nature of the Californian peninsula and gulf. This question was nevertheless destined to prove one of the most vexed of all problems in Pacific geography; not to be finally settled for over 200 years, and giving rise during that time to many curious mistakes in maps and records.